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Annual Report on the Federal Department of Agricultural Research

FOR THE YEAR 1966-67

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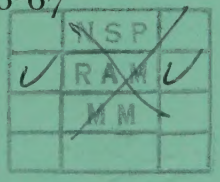

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ANNUAL REPORT

ON

THE FEDERAL DEPARTMENT OF

AGRICULTURAL RESEARCH

1966-67

CONTENTS

	Pages
Staff List	5
Review of Research	9
Report on the Chemistry and Soils Division	10
Report on the Entomology Division	
Pests of Rice	16
Pests of Citrus	18
Pests of Sugar Cane	20
Pests of Yams	22
Report on the Maize and Legume Division	
Maize Breeding	23
Cowpea Physiology	28
Report on the Rice Research Unit	28
Upland Rice	29
Irrigation of Swamp Rice	29
Floating Rice	31
Report on the Plant Pathology Division	
Rice Diseases	32
Maize Diseases	33
Cowpea Diseases	33
Report on the Plant Introduction and Plant Quarantine Services	35
Appendices:-	
(*i*) Meteorological data, Moor Plantation	37
(*ii*) Meteorological data, Rice Research Station, Badeggi	37
(*iii*) Analysis of establishment	38

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	Name	Rank	Date
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REVIEW OF RESEARCH

Crop improvement

A major objective in the improvement of crops is to obtain varieties which are resistant to particular diseases. It is even more desirable to obtain varieties which combine resistance to more than one disease with high yield and quality. This can be achieved partly by screening available varieties and partly by breeding. Considerable work was done along both lines for maize, upland and swamp rice. All floury maize varieties, except one, were susceptible to rust, and most to blight. Many dent varieties were resistant to either rust or blight. Only the maize variety Sicaragua was resistant to both rust and blight.

The uniform blast nursery technique has been properly developed for routine testing of rice for resistance to blast disease caused by *Pyricularia oryzae*. Hundreds of introduced varieties and progenies were screened for resistance. Considerable differences in the levels of resistance were noted, indicating a rich germplasm for further breeding work. Resistance to this disease is being combined with several other characters like short straw, short duration, long grain and high yield. Work has progressed to the stage where several blast resistant varieties were tested for yield in several trials.

Studies have been intensified to produce maize varieties which are properly adapted to the Savannah zone of Nigeria. So far, the varieties H.507, NS.5 and Eafro 237 have proved promising.

The work on cowpea has been enlarged to include studies on the characters which can be most fruitfully used for classification, as well as varietal yield trials and the physiological basis of differences in grain yield. Large differences were found between the grain yields and yield components of the varieties, and correlations between characters were established.

Crop protection

Much work continued on the protection of crops from diseases and pests. In order to provide a clearer understanding of the behaviour of insect pests and so reveal the most vulnerable portions of their life-cycle, the biology and ecology of many insect pests were studied. Following previous similar studies, experiments were carried out on cultural methods of controlling insect infestation in rice through changing the planting dates. The natural occurrence of parasites of pests of citrus and sugar cane was studied and prospects examined for the biological control of the pests.

Various types of fungicides and insecticides were screened for use on maize, rice, sugar cane and citrus. Pathological work on cowpea was confined primarily to screening about 300 varieties for resistance to yellow mosaic virus and mottle virus.

G. E. O. Okiy,
Director of Agricultural Research

REPORT ON THE CHEMISTRY AND SOILS DIVISION

SOIL AND PLANT ANALYSIS

Determination of organic carbon

The principle of the indirect wet oxidation method of determining organic carbon is dependent on the oxidation of the carbon to carbon-dioxide. In the Walkley and Black method complete oxidation is effected by a *normal* solution of cold acid dichromate. Tinsley, using a lower concentration of dichromate, considers that complete oxidation may be achieved by gentle reflux, especially for soils with high organic matter content. An investigation was carried out to determine which of the two methods is more suitable under our conditions.

Standard solutions of glucose containing 0-20 mg. of carbon were treated with an aliquot of standard potassium dichromate. The excess of chromic acid was titrated with standard ferrous ammonium sulphate. About 81 per cent of the carbon was recovered with cold 0.4N potassium dichromate; recovery was 99.6 per cent when the 0.4N hot solution was gently refluxed for one hour. When cold normal potassium dichromate was used, recovery was 99.6 per cent.

To determine the comparative efficiency of the cold and hot oxidation methods the carbon content of three different soils was determined in duplicate. The results are shown in Table 1.

TABLE 1—COMPARISON OF HOT AND COLD OXIDATION METHODS FOR ORGANIC CARBON

Sample	*Carbon content as percentage of soil*	
Number	*Cold oxidation with normal dichromate*	*Hot oxidation with diachromate 0.4N*
1	1.90	1.89
2	2.10	2.00
3	1.84	1.79
Mean	1.95	1.89

There is no significant difference in the values obtained by the two methods. Oxidation with cold *normal* potassium dichromate is preferred since it is faster than the hot oxidation method.

Determination of soil phosphate

Experiments were conducted to determine the most suitable methods for estimating the phosphorus content of soils and plant materials, including the relative advantages of Bray and Kurtz's extractant and Olson's bicarbonate extractant in the molybdenum blue method for soils.

It was concluded that when the concentration of soil phosphorus is between 0 and 100 p.p.m., the molybdenum blue method using Bray and Kurtz No. 2 solution as extractant is most suitable. The phospho-molybdic heteropoly has a stability of about fifteen minutes with the Bray and Kurtz, but only about five minutes with the bicarbonate extractant.

When the soil phosphorus is up to 800 p.p.m., and it is desired to determine total phosphorus, extraction should be with perchloric acid, and determination should be by the phosphovanadomolybdate yellow. For plant material, the phosphovanadomolybdate method is most suitable.

Determination of exchangeable bases

An experiment was designed to ascertain the necessity for, and the effectiveness of, the removal of interfering ions from leachates prior to the determination of exchangeable bases. Furthermore, a comparison was also made of the degree of recovery of exchangeable bases from a water extract of aqua-regia-digested soil (Cheng and Bray) and from a direct ammonium acetate leachate of soil after masking the interfering ions. The results are given in Table 2.

TABLE 2.—DETERMINATIONS OF EXCHANGEABLE BASES

A. Calcium (meq Ca/100 gm. air dired soil)

Sample No.	140	141	142	143	144
Chloride extract with interfering ions	uncertain end point				
Chloride extract minus interfering ions	1.76	1.99	1.38	1.99	0.77
Water extract of aqua-regia-digested Soil minus interfering ions	1.90	1.77	1.16	1.96	1.04

B. Magnesium (meq Mg/100 gm. air dired soil)

Sample No.	140	141	142	143	144
Chloride extract with interfering ions	uncertain end points				
Chloride extract minus interfering ions	0.60	0.60	0.31	0.69	0.15
Water extract of aqua-regia-digested soil minus interfering ions	0.67	0.67	0.60	0.80	0.37

C. Potassium (meq K/100 gm. air dired soil)

Sample No.	2519A	2519B	2566A	2566B
Direct leachate	0.3683	0.3376	0.2148	0.2148
Chloride extract minus interfering ions	0.2302	0.2686	0.1534	0.1534
Water extract of aqua-regia-digestion	0.3376	0.3376	0.2148	0.2762
As above after Cheng and Bray removal procedure	0.2148	0.1995	0.1381	0.1228

D. Sodium (meq Na/100 gm. air dired soil)

Sample No.	2519A	2519B	2566A	2566B
Direct leachate	0.03915	0.03915	0.019575	0.019575
Chloride extract minus interfering ions	0.04893	0.04893	0.02447	0.02447
Water extract of aqua-regia digestion	0.03915	0.03915	0.06526	0.08482
As above after Cheng and removal procedure	—	—	—	—

The following conclusions were reached:

(*a*) Direct estimation from the ammonium acetate leachate without masking the interfering ions gives uncertain end-points during Versanatae titrations for Ca and Mg, and incomplete recovery of the alkali cations.

(*b*) The water extract from the aqua-regia-digested soil gives higher exchangeable base recovery in the case of Ca and Mg.

(*c*) The interfering ions hardly affect the estimation of Na and K in both the masked ammonium acetate leachate and the aqueous extract from the aqua-regia-digested soil.

The individual exchangeable bases are best estimated after masking the interfering ions in ammonium acetate leachates.

Determination of cation exchange capacity

Surface samples were collected from the two major soil series on Moor Plantation—the Ibadan series and the Apomu series. The cation exchange capacity was determined by leaching soil samples with neutral **2-normal** ammonium acetate solution for 4 to 17 hours. The excess ammonium ions was washed with alcohol of pH 7.0. The leachate was distilled with magnesium oxide, the ammonia absorbed in boric acid, and the excess boric acid titrated. The cation exchange capacity of the Apomu series ranged from 1.95 to 4.84 m.eq/100 gm, with mean value of 2.95 m.eq. This was markedly higher than the values of the Ibadan series which ranged from 1.20 to 1.79 m.eq/100 gm, with mean of 1.57 m.eq. This indicates that Apomu series contains a greater number of cations in an exchangeable form than the Ibadan series and would also be expected to produce greater response to applications of fertilizers.

Studies on symbiotic nitrogen fixation

The effect of four elements on the formation of active root nodules by cowpeas was studied in a pot test at Moor Plantation. Calcium as hydrated lime, nitrogen as ammonium sulphate, molybdenum as ammonium molybdate and phosphorus as superphosphate were compared at three levels in a 3^4 factorial trial, using soil taken from each of the 81 plots of the 1966 field experiment. Soil samples were taken at the beginning and end of the experiment. The results showed that the soil nitrogen was consistently depleted during the experiment. Application of calcium, molybdenum and phosphorus did not stimulate nodulation sufficiently to bring about any enrichment of the soil with nitrogen.

Cassava starch

The method previously in use for routine estimation of starch percentage in cassava tubers was derived from that of Boss of the Arrowroot Co-operative Society of St. Vincent,

as recommended by the Tropical Products Institute. It is based upon estimating the specific gravity of the starch. However, the presence of other insolubles besides starch necessitates corrections which are difficult to make. Consequently, the percentages of starch previously obtained were found to be low in comparison with those obtained by the expensive polarimetric method.

The following method has now been evolved and adopted for routine determination of starch content in cassava.

(*a*) Peel, wash and crush the tubers.
(*b*) Weigh out quickly and accurately 100 g of crushed material.
(*c*) Wash with two to three litres of fresh water through 120 mesh sieve.
(*d*) Allow sediment to settle, then pour off supernatant liquid.
(*e*) Make the starch precipitate up to one litre with water.
(*f*) Centrifuge 10 mls. aliquot of this suspension and transfer the sediment to a weighed evaporating dish, resettle, decant and dry the residue in an oven at 105°C to constant weight (W).
(*g*) Determine the starch percentage of triplicate samples by polarimetry.

The percentage starch (Ss) is therefore 100W and, if the percentage starch obtained by polarimetry is Sp, then a correction factor Sp/Ss can be obtained for each variety. Once this is obtained, all that is required is to proceed from (*a*) to (*f*) as above and multiply by the correction factor. Thirty-four samples of variety 44086 were analysed as above. The correction factor was 0.681 and the mean starch percentage was found to be 26.08.

HCN content of cassava

The hydrogen cyanide content of the standard variety 53101 was previously reported to be 1.13 mg. HCN/100 mg. of sample (Quarterly Res. Bull. Nos. 11 and 12). As this did not amount to a toxic quantity the content of HCN in these cassava tubers was re-examined. An improved method of steam distillation was used to recover 70 mg. HCN/100 gm. of sample. Thus, the variety 53101 does not differ much from other cassava varieties in HCN content. However, it is doubtful whether it is necessary to carry out routine analysis of the hydrogen cyanide content of cassava. The traditional methods of preparing cassava in Nigeria eliminate the hydrogen cyanide in the process. The need to determine HCN content would only arise in areas where sweet cassava is taken fresh.

Moisture content of gari

A comparison was made of the Dean and Stark method, believed to be more reliable but involving the use of costly xylene, with the 'Speedy' moisture tester which is fast but not so accurate. The moisture content of gari, prepared from four cassava varieties, was determined by both methods. However, the results shown in Table 3 indicate a reasonable agreement between the two methods.

TABLE 3—MOISTURE CONTENT OF 'GARI' BY TWO METHODS

Variety	*Speedy moisture tester*	*Dean and Stark method*
	Moisture content (%)	*Moisture content* (%)
60447	4.5	4.3
53101	4.5	3.8
37065	2.9	3.2
44086	3.2	3.0

Medium term fallow experiment

The relative merits of five fallow species, namely, *Panicum maximum*, *Pennisetum purpureum*, *Tripsacum laxum*, *Andropogon gayanus* and *Stylosanthes gracilis* are being studied at Moor Plantation to determine the relative improvements in soil fertility after the fallow period. A ten-weekly cutting regime has been adopted based on work done elsewhere. On Moor Plantation, however, *Stylosanthes gracilis* has failed to withstand the strain of this cutting regime—the number of stands decreased and weed infestation increased with time during the fallow period. This would adversely affect the value of this species as a fallow under this management regime.

Rate × Method × time of application of N on transplanted swamp rice

A 3^3 factorial rate × method × time of nitrogen application trial was started in 1965 at Badeggi. Nitrogen was applied as sulphate of ammonia at the following rates—0 Cwt. (NO), 2 Cwt. (N1) and 4 Cwts. (N2) per acre of sulphate of ammonia.

Methods of nitrogen application were—

(*a*) Whole quantity applied and hoed into the soil before transplanting.

(*b*) Split application: half quantity applied seven days after transplanting (broadcasting).

(*c*) Split application: half quantity applied seven days after transplanting by deep placement between rows.

The second time of nitrogen application—

(*d*) 42 days after first application.

(*e*) 30 days before flower emergence.

(*f*) At flower emergence.

Grain and straw samples were taken at the final harvest and chemically analysed for total N,P,K, Ca and Mg. The amount of nitrogen recovered by plants from the fertilizer was calculated.

There were no significant differences in the nitrogen content of the grain between times and methods of nitrogen application; however, there were significant differences in the nitrogen content of the grains between the rates of nitrogen application.

The percentage of fertilizer nitrogen recovered in the plant was greater at N_2 (23.2%) than N1 (17.6%); the percentages of the different methods of application were (*a*) 26.1, (*b*) 22.3 and (*c*) 12.0 respectively; for the second time of nitrogen application were (*d*) 22.2, (*e*) 19.7 and (*f*) 19.3 respectively.

Varieties × rates of application of Nitrogen on transplanted Swamp Rice

In 1963, a trial was started at Badeggi to study the interactions between varieties and nitrogen levels. The levels of nitrogen were 0, 1, 2, 3 and 4 cwts. per acre of sulphate of Ammonia and the varieties used in 1965 and 1966 were BG. 79, D.114, Makalioka 823 and MAS. 2401.

The grain and straw samples were taken at harvest in 1965 and were chemically analysed for total N, P, K, Ca and Mg. In 1966, only grain samples were taken and analysed for total Nitrogen.

Although there were no significant differences in the nitrogen content of the grain between the various levels of nitrogen in 1965, the differences in 1966 were highly significant. The mean nitrogen percentages were 0.92, 0.93, 1.02, 1.08 and 1.15 at 0, 1, 2, 3 and 4 cwts. per acre of sulphate of ammonia respectively.

The nitrogen content of grains of different varieties showed highly significant differences both in 1965 and 1966. The mean percentages in 1965 were 0.98, 0.88, 0.79; in 1966, they were 1.05, 1.06, 0.98, 0.97 for Makalioka 823, MAS 2401, D.114, and BG. 79 respectively.

The correlation between the yield of grain and the nitrogen content of the grain was not clear.

Nutrient content of Irrigation water

Samples of irrigation water were collected once a month from the Fadama at the Federal Rice Research Station, Badeggi, Luguma near Kateha, Edozhigi and Kupanho at Wuya Suma all in Niger Province. Water samples were also collected at low and high tide once a month from the field of the Federal Rice Research Sub-Station, Warri. These water samples were analysed for pH, K, Na, Ca and Mg.

The irrigation water in the Niger Province is high in potassium content and is very low in Ca and Mg. The average content of potassium was 4.43, 3.51, 2.86 and 1.92 ppm at Badeggi, Luguma, Wuya Suma and Edozhigi respectively. There was a slight increase in potassium and Calcium in the months of May and June.

Uptake of nitrogen from ammonium sulphate by seedlings of MAS 2401

An experiment was carried out at Badeggi in growth tanks to study the utilization of applied nitrogen by seedlings of MAS 2401 and the rate of loss of nitrogen through leaching. Nitrogen was applied 14 days after transplanting at the rate of 0 (No), $1\frac{1}{2}$ (N1), and 3 (N_2) cwts. per acre of sulphate of ammonia.

Sampling of plant and surface water was done at two days intervals from the 14th to the 28th day after transplanting. Drainage water was sampled during the same interval from the third day after transplanting. Soil samples from 0—10cm. were taken before transplanting and at two days' interval from the 14th to the 28th day after transplanting.

The quantity of ammonium—N in soil from the tanks with applied nitrogen reached the highest value four days after the application of nitrogen, and then decreased. On the whole, the values were bigger at higher levels of applied nitrogen.

The quantity of ammonium—N in the surface water of the tanks increased remarkably with nitrogen application, and reached to a maximum two days after application, and thereafter decreased; after two weeks only traces were detectable. The percentage excess of N relative to the control were 47.5, 54.0, 26.2 and 35.7 two days and four days after application in low and high nitrogen application respectively.

The nitrogen content of the plants in the tanks with applied nitrogen reached a maximum eight days after application and then decreased. The values were bigger at the high levels of applied nitrogen.

REPORT ON THE ENTOMOLOGY DIVISION

PESTS OF RICE

Pest population

Light trap collections of pests of rice continued both at Badeggi station and in the Fadama. During the rainy and dry seasons of 1966, *Sesamia calamistis*, *Chilo* sp. and *Hypsotrapha subcostella* were collected in large numbers indicating that these insects continued to breed during the dry season, and there was no diapause. However, during the dry season there was complete absence of *Miliarapha separatella; Scirpophaga* sp. was collected in fewer numbers than in the rainy season when these two species were recorded in very large numbers. This suggests that both species undergo diapause during the dry season.

Samples were also taken from rice tillers and stubbles starting from December 1965 to May 1966 to assess the borer damage along with the percentage larvae of different species present. The data indicate that the percentage of bored tillers and stubbles ranged from 32.3-34.6 per cent. The majority of the larvae collected were of *H. subcostella* and *Scirpophaga* sp., (Table 4).

Rice stubbles and grasses were sampled during April from different localities in Northern Nigeria. There was a large population of stem borers in rice stubbles whereas there was none in grasses, (Table 5). Larvae of *Scirpophaga* sp. *Eldana saccharina* and *Hypsotrapha subcostella* were usually found in the lower nodes of the plant, while those of *Sesamia* sp. and *Chilo* sp. were found amongst the upper internodes. In a few cases larvae of *Scirpophaga* sp. and *Eldana* sp. were also found as low as the sixth internode, and those of *Sesamia* sp. and *Chilo* sp. were collected from even lower internodes.

TABLE 4.—PERCENTAGE POPULATION OF STEM BORER (LARVAE) SPECIES IN RICE AND STUBBLES IN BADEGGI AREA

Date examined	*No. of Samples*	*Type of sample*	*No. of Stem examined*	*No. of Stem bored*	*Percentage bored*	*Total No. of larvae*	*Percentage of larvae*				
							Sesamia	*Chilo*	*Hypsotrapha*	*Scirpophaga*	*Malirapha*
4.X-18.XII	15	Rice (KAV 12)	2254	728	32.3	473	2.1	2.7	57.3	37.9	0
10.XII-9.II	14	Rice Stubbles (Badeggi farm)	2615	861	32.9	380	4.5	6.3	47.3	39.5	2.4
15.III-2.V	13	Rice Stubbles (Native farm)	3499	121	34.6	737	0.5	3.2	76.9	18.2	1.1

TABLE 5.—STEM BORER POPULATION IN RICE AND GRASSES IN BADEGGI AREA

Crop	*No. of Stems examined*	*No. bored*	*Stem borer population*				
			Hypsotrapha	*Scirpophaga sp.*	*Chilo sp.*	*Maliarapha sp.*	*Sesamia sp.*
Rice	2640	599	102	38	2	1	3
Grasses	200	15	0	0	0	0	0

The effect of date of planting on the incidence of stem borer damage at Bende

Three varieties of rice, KAV 12, BG 79 and MAS 2401 were planted at monthly intervals between August and October at Bende. The plantings were sampled at three weeks intervals. A sample comprised fifty tillers. These were dissected and the borer larvae within the stems were identified. The principal species was *Hypsotrapha subcostella.* Occasional *Diopsis* and *Chilo spp.* larvae were found. The percentages of bored stems are compared in Table 6.

TABLE 6—THE EFFECT OF DATE OF PLANTING, AGE AND VARIETY ON INCIDENCE OF RICE STEM BORER DAMAGE AT BENDE

Date transplanted	*Date Sampled*	*Age in weeks*	*Percentage of tillers bored*		
			KAV 12	*BG* 79	*MAS* 2401
3–8–66	26–10–66	12	20	8	6
	16–11–66	15	28	24	18
	7–12–66	18	34	28	24
	29–12–66	21	40	36	24
7–9–66	19–10–66	6	6	0	0
	9–11–66	9	2	0	0
	30–11–66	12	24	0	0
	21–12–66	15	22	10	4
12–10–66	14–12–66	9	0	0	0

The varieties being sensitive to photoperiod, all plantings flowered almost simultaneously despite the differences in planting date. They were all harvested in January 1967. Infestation increased with age, and by December 1966 the percentage of bored stems was highest in the rice planted in August. However, in the variety KAV 12, there was very little difference in the infestation of 12 and 15 weeks old plants planted in August and September. The infestation of BG 79 and MAS 2401 was much reduced by later planting. KAV 12 has thicker stem than BG 79, and MAS 2401 has the most slender stem of all. It has been noted elsewhere that stem borer damage may be positively correlated with stem diameter, and the selection of slender stem lines may produce increased resistance to stem borers.

Insecticidal control trial in swamp rice

A field trial to compare the effectiveness of three formulations of B.H.C. viz: Gammalin 20, Agrocide 26 and Gammexane 50 in the control of rice stem borers was carried out at Bende. The insecticides were applied to the irrigation water in split applications. Three and five pounds active ingredient B.H.C. were applied on the 8th and 15th weeks after transplanting and compared with three periods of applications during which 2, 3 and 3 lbs. a.i. applied on the 8th, 12th and 17th weeks respectively after transplanting. The controls were untreated. The trial was laid out as a randomised block design, each plot having independent irrigation and drainage. Samples of tillers were taken throughout the growing period to assess the damage by borers. The percentage of tillers bored at flowering on 30–11–66,

and at harvest on 29–12–66, are shown in Table 7 below, which also contains the yields at the different treatments. Although the yields of the treated plots were greater than the control, the differences were not significant and the experiment will be repeated in 1967.

TABLE 7—EFFECT OF THREE FORMULATION OF B.H.C. ON THE INCIDENCE OF STEM BORER ATTACK AND YIELD OF RICE

Treatments	*Percentage tillers attacked on*		*Yield per acre in lbs*
	30–11–66	29–12–66	
Control	27	40	1,923
Gammalin 20 (Two applications)	4	32	2,506
Gammalin 20 (Three applications) ...	3.5	9	2,993
Gammexane 50 (Two applications)	20.5	30.5	3,176
Gammexane 50 (Three applications)	5.0	17.5	2,931
Agrocide 26 (Two applications)	10.0	25.5	2,423
Agrocide 26 (Three applications) ...	10.0	12.0	3,370

PESTS OF CITRUS

Biology of citrus purple scale (L. beckii)

Studies on the biology of the citrus purple scale continued in the insectary at Umudike. The insects were reared on young potted sweet orange and rough lemon seedlings. On sweet orange, the average duration required for development from crawler to egg producing stage was 37.8 days at a temperature of 83.4 + .6°F and humidity of 73 per cent; males emerged in 30.8 days. On rough lemon under the same conditions the developmental period was 36.3 days; males were obtained in 32 days.

It was also observed from the reared adults that the males significantly outnumbered the females (P/_.001). This agrees with the observations on the preponderance of males on infested trees in the field.

Seasonal population

The observations on biology of *L. beckii* on sweet orange (Nigerian Green Orange) continued at Umudike. Counts of scales were made from 200 leaves selected from ten trees under observation at fortnightly intervals. The number of dead and living scales on each leaf were counted and the cause of death was determined in the laboratory, Table 8. The data indicates that death due to fungus attack was severe during the wet season, whereas by dessication reached its peak during the dry season months of December and January. Death due to insect parasitism ranged from 2.3 to 25.8 per cent.

TABLE 8—SEASONAL POPULATION OF L. BECKII ON SWEET ORANGE AT UMUDIKE

Month	Percentage survived	Percentage dead and cause of death		
		Fungus attack	Insect parasitism	Dessication
April 1966	73.3	4.4	2.3	20.0
May	63.7	14.1	8.0	14.2
June	37.8	27.0	13.6	21.6
July	3.3	49.1	25.8	21.8
August	3.6	49.1	24.2	23.1
September	15.2	45.7	21.2	17.9
October	18.4	23.0	23.4	35.2
November	29.4	11.7	21.7	37.2
December	18.9	8.9	21.5	50.7
January 1967	28.7	—	16.0	55.3
February	43.3	0.9	13.4	42.4
March	67.3	2.2	16.2	14.3

Insecticide control of L. beckii at Umudike

Three most promising insecticides, Malathion 40 E.C., DDT 25 E.C. and Dimethoate 30 E.C. (Rogor 40 E.C.) selected after a series of trials for the control of the purple scale were tested at increased dosages.

Randomized single tree plots replicated four times were used to study the effect of the three insecticides either alone or in combination with oil (albolinium No. 2). Sprays were applied with a motorized sprayer, using $2\frac{1}{2}$ gallons for four trees to dripping point. The trial was continued in about 0.4 acre. The results presented in Table 9 indicate that Malathion alone or in combination with oil was significantly better than any of the other treatments.

TABLE 9.—EFFECT OF THREE INSECTICIDES ON THE MORTALITY OF PURPLE SCALE

Insecticide	Dosage	Mean percentage mortality
Malathion 40 E.C. + oil	.05 and .06 pints/gallon of water respectively	93.69*
Malathion 40 E.C.	.07 pint/gallon of water	93.11
Dimethoate 30 E.C. + oil ...	.05 and .06 pints/gallon of water respectively	75.74
Dimethoate 30 E.C.	.07 pint/gallon of water	52.31
DDT 25 E.C. + oil	.05 and .06 pints/gallon of water respectively	24.00
DDT 25 E.C. + oil	.07 pint/gallon of water	8.54
Oil alone	.07 pint/gallon of water	5.74

(Any two means joined by the same vertical line are not significantly different at 5 per cent level—Duncans Multiple Range Test.)

*Percentage mortality was corrected using Abbott's (1925) formula.

Predators

At Umudike, a coccinellid beetle, *Chilocorus schiodtei* Muls., was observed feeding on the purple scales and a daily collection for one and a half years in the citrus orchard showed that there is regular rhythm in the populations of predator and purple scale. The predator population was the highest in June, when the purple scale population was also at its peak. The data on the predator population for the various months are given in Table 10.

TABLE 10—POPULATION OF CHILOCORUS SCHIODTEI AT UMUDIKE

Month	*No. of Coccinellids*
March	159
April	287
May	215
June	366
July	147
August	141
September	176

PESTS OF SUGAR CANE

Stem borers

The studies on stem borers and their parasites continued at Bacita. The population of stem borers remained low; of the 4240 stems examined, only 8 per cent were bored. It would appear that the population of borer parasites is increasing and are maintaining the borer population at a low level.

Twelve species of parasites belonging to the orders Diptera and Hymenoptera were reared from sugar cane stem borers at Bacita, during this study. The date on the parasites and the hosts from which they were reared are listed below.

DIPTERA

Tachnidae

Sturmiopsis parasitica Curran, on larvae and pupae of *Sesamia* spp. and also on larvae of *Eldana* sp.

Descampsina sesamiae Mensil, on larvae and pupae of *Sesamia* sp.
Nemoraea bequaerti Emden, on *Sesamia* larva
Chromatophania picta Weild, on *Sesamia* larva
Gen. nr. *Metopisisyrops* Tns. on *Sesamia* larva

HYMENOPTERA

Eulophia

Tetrastichus sp., on pupae of *Sesamia* sp.

Pediobius furvum Gah., on pupae of *Sesamia* sp.

Icheumonidae

Enicosphilus spp, on *Sesamia* larvae
Coclichneumon spp, on *Sesamia* pupae
Chasmias spp, on *Chilotrea* larvae.

Braconidae

Braunsis occidentalis End. on *Sesamia* larvae
Apanteles sesamiae Cameron, on *Sesamia* larvae

Sesamia spp. larvae were the main borers attacked by the parasites. *Eldana saccharina* and *Chilotrea* spp. were found parasitised only during the dry season, from January to April and parasitism never exceeded 3 per cent of larvae examined during these months. *Descampsina sesamiae*, Mensil was the major parasite found on *Sesamia* spp. larvae. Parasitism on borers in the field range from 12.2 to 16.8 per cent during 1964-66, Table 11. The population of various parasite species during this period varied considerably, Table 12.

TABLE 11.—PERCENTAGE PARASITISM AMONGST SUGAR-CANE STEM BORERS AT BACITA DURING 1964-66

Year	*No. larvae collected*	*No. parasitised*	*Percentage parasitism*
1964	5355	651	12.2%
1965	4791	807	16.8%
1966	2611	338	12.9%

TABLE 12.—PERCENTAGE POPULATION OF PARASITES SPECIES ON SUGAR-CANE BORERS DURING 1963-65

Parasite	*Percentage population*		
	1963	1964	1965
Diptera:			
Tachnidae			
Descampsina sesamiae	84.0	80.5	73.0
Sturmiopsis parasitica	5.0	9.0	14.0
Nemoraea bequaerti	0	1.0	0
Chromatophania picta	0.5	0	0.5
Gen. nr. *Metoposisyrops*	0	0	0.5
Hymenoptera:			
Eulphidae			
Tetrastichus sp.	1.0	0	0
Pediobius furvum	1.0	2.0	3.0
Icheumonidae			
Enicosphilius sp.	0.5	1.0	2.0
Coclichneumon sp.	0.5	0	0
Gen. nr. *Chasmias* sp.	0	0.5	0
Braconidae			
Braunsis occidentalis	2.0	6.0	6.3
Apanteles sesamia	0.5	0	0.5

Descampsina sesamiae was found to attack all the larval instars and pupae of *Sesamia* spp. The pupal stage of *D. sesamiae* in the laboratory lasted from 7 to 11 days. The female oviposited within 48 hours after emergence in a cage containing *Sesamia* spp. larvae. The adults lived for four to eight days. One or more eggs were deposited on the body of host larva. On hatching the young parasite larva entered the host. In many cases three pupae were obtained from one host larva. Usually, the host larva died before the parasite pupated. The parasite larva emerged from the body of host larva and pupated close to it. The life history of *D. sesamiae* in the laboratory was completed in 25-38 days.

Alternative host plots

Coniesta spp. was not recorded on sugar cane and grasses last year. It was observed on grasses in small numbers and on cereals in large numbers but not on sugar cane this year. Grasses and cereals continued to support populations of *Sesamia* spp. *Eldana* spp. was not found on grasses throughout, but few were collected from cereals.

Chilotrea spp. was absent throughout the year on cereals but was found in small numbers on grasses during June.

PESTS OF YAMS

Yam beetle population studies

Larval populations in the breeding areas were studied at Agenebode in the Midwestern Nigeria and Onitsha in Eastern Nigeria. The populations were studied by taking 18 × 18 × 18 inch samples of surface soil from the breeding areas and collecting the larvae in the soil. During January at Agenebode all the three larval stages were collected, Table 13.

TABLE 13.—LAVAL POPULATION OF YAM BEETLES AT AGENEBODE AND ONITSHA

Month	*Agenebode*				*Onitsha*			
	No. of samples taken	*Number of larvae collected*			*No. of samples taken*	*Number of larvae collected*		
		1st instar	*2nd instar*	*3rd instar*		*1st instar*	*2nd instar*	*3rd instar*
January	238	267	82	—	136	64	2	0
February	236	336	186	65	160	130	19	0
March	242	306	304	124	186	82	58	76

These data indicate clearly that the breeding cycle of yam beetles begins earlier at Agenebode than at Onitsha.

PESTS OF SWEET POTATO

Species collection at Ibadan

Regular collection of pests from sweet potatoes around Ibadan were made. The species collected are *Aspidomorpha* 5—*fasciata F.*, *A. dissentanea* Boh., *A. concinna* Wse., *A. nigromaculata* Klg., *Chirida quadriplagiata* Hoh., *Epilachna* sp., *Laccoptera corrgata* Sahl., *Lagria villosa* F., *Chrysolagria* sp. and many species of grasshoppers.

Aspidomorpha spp. were the commonest pest found on the sweet potato leaves and both adults and larvae caused damage. The life history of one of these species has therefore been studied with a view to evolving a control method.

Life history of *Aspidomorpha 5-fasciata* F.

The eggs are deposited in a dome-shaped ootheca which consists of a number of brown flaps glued together on one side. Each flap, except one or two on the top and bottom, has two light greenish cylindrical eggs on it. The ootheca is glued to the under surface of the leaf and looks like a tiny brown dot. Usually, an ootheca has eight to fourteen eggs in it.

In the laboratory the egg hatches in four to nine days and the larva undergoes four moults in a period of fourteen to seventeen days. The larva is short and oval, somewhat flattened and the cast skin is attached to the forked caudal process which gives the larva an unusual appearance.

The larva pupates while still attached to the surface of the leaf. The pupal period lasts from four to six days. The newly emerged adult mates in four to five days and start laying eggs in another four to seven days. The adult seems to live for long, because those collected from the field in July continued to deposit eggs till October.

REPORT ON THE MAIZE AND LEGUME DIVISION

MAIZE BREEDING

Breeding for disease resistance

Two serious diseases of maize in Nigeria are the American maize rust caused by *Puccinia polysora* and the Southern leaf blight caused by *Cochliobolus heterostrophus*. In collaboration with the Plant Pathology Division, 388 inbred lines of floury and 805 inbred lines of dent maize were screened for resistance or susceptibility to these two diseases. The objective was to obtain resistant lines for breeding purposes. The results are shown in Table 14.

TABLE 14.—NUMBER OF RESISTANT AND SUSCEPTIBLE VARIETAL LINES TO MAIZE RUST AND LEAF BLIGHT

Varietal lines from	*Rust*			*Blight*			*Rust and Blight*			*Total*
	A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*	
Floury										
Akwete white	0	0	20	1	2	17	0	0	1	20
Bende local	0	0	58	0	3	55	0	0	8	58
Bende white	0	0	96	0	27	69	0	0	0	96
Ikom white	0	1	43	0	36	8	0	1	3	44
Ugep white	0	0	72	0	7	65	0	0	14	72
V—1	0	0	98	21	77	0	0	0	0	98
TOTAL	0	1	387	22	152	214	0	1	26	388
Dent										
Eafro 231	2	47	181	0	63	167	0	17	47	230
Diacol-V.153	37	63	137	2	53	182	0	13	63	237
H. 503	1	8	90	1	0	98	0	0	49	99
H. 507	0	35	64	0	0	99	0	0	44	99
Mexico 5	0	1	32	4	16	13	0	0	8	33
Niaouli-7	0	1	58	53	6	0	0	0	0	59
Sicaragua	1	6	41	2	29	17	1	5	13	48
TOTAL	41	162	603	62	167	576	1	35	224	805

A=High resistance. B=Moderate resistance. C=Susceptible.

All except one of the floury lines were susceptible to the rust. Most of them were also susceptible to the blight, although some were moderately or highly resistant. The dent lines had many more members resistant to the rust or blight. Only one dent line (from Sicaragua) combined high resistance to both diseases. These results indicated that some of the introduced dent varieties had been selected for resistance for these diseases while all the local floury cultivars were not. Evidently the variety V—1 was bred for resistance to the Southern blight disease and so will be used extensively in future maize breeding programmes.

Varietal trials

(*a*) During 1965 and 1966 attempts were made to obtain maize varieties which were properly adapted to the Savannah zone of Northern Nigeria, for use in breeding high yielding and acceptable synthetics for that zone. In each year 25 varieties selected on the basis of genetic and agronomic characters were planted at Mokwa in randomised complete block experiments. The results are shown in Table 15.

TABLE 15.—COMPARATIVE GRAIN YIELDS OF SOME MAIZE VARIETIES PLANTED AT MOKWA IN 1965 AND 1966

Varieties	*Grain yield in lbs/acre*		
	1965	1966	*Mean*
H.507	3010	1900	2455
NS.5	3163	1741	2452
Eafro 237	2956	1705	2350
Bida white	2952	1705	2328
NS.1	2092	1820	1956
Lagos white	2034	1082	1558
K.50	1833	596	1214
Mean	2282	1232	1757
C.V. (%)	13	31	—
L.S.D. (5%)	352	465	—
„ (1%)	466	610	—

Grain yield was higher in 1965 than 1966, and when the variances for the two years were tested for homogeneity they were significantly different ($P=0.05$). The data for each year were, therefore, analysed separately. For both years the varieties H.507, NS.5 and Eafro 237 produced the best average yields.

(*b*) In renewed efforts to discover more maize varieties with germplasm for high yields and other agronomically important traits, 44 open-pollinated varieties were planted in complete randomized block trials at Ibadan and Umudike. The trial was in six replications and it included 37 local and introduced floury varieties and seven non-floury ones. The seven highest yielding varieties at both locations are given in Table 16.

TABLE 16.—THE HIGHEST YIELDING VARIETIES AT IBADAN AND UMUDIKE IN 1962

Moor Plantation		*Umudike*	
Variety	*Yield (lbs/acre)*	*Variety*	*Yield (lbs/acre)*
Eafro 231	4140	Eafro 231	3494
NS.5	3015	NS.5	3177
NS.1	2779	Awgu-5	3126
Ogbomosho	2316	Diacol-V.153	3056
Buganda	2260	NS.4	2873
Ugep white	2246	Niaouli-7	2863
Bende-2	2211	Sicaragua	2803
Mean	1779	Mean	2109
Range	648–4148	Range	525–3494
C.V. (%)	19.0	C.V. (%)	24.0
S.E. (±)	180.7	S.E. (±)	204.9
L.S.D. (5%)	503.3	L.S.D. (5%)	568.0
„ (1%)	664.3	„ (1%)	746.5

The mean yields at Umudike was 11.9 per cent greater than that at Ibadan. In a joint analysis of the data from the two locations, the variety × location interaction was not large enough to be significant. The introduced dent variety, Eafro 231, and the synthetic variety, NS.5, gave the highest yield at both locations. Eafro 231 yielded higher than NS-5 at both places but the difference was not significant at Umudike. It was noted that at both locations the dent varieties always gave the best yields.

Evaluation of inbred lines

In 1965 top crosses were made between seven selected inbred lines and three varieties (Federal Department of Agricultural Research Report for 1965/66). In 1966, these top crosses and their parents were planted at Ibadan to test the general combining ability of the inbreds. Of the 185 top crosses tested with Lagos white, 126 yielded more than the parental mean. Among the latter hybrid vigour was expressed in the grain yields of most of the top crosses involving inbred lines of Diacol-V.153, Bende White and Bende Local. But when tested with Eafro 231 and Sicaragua most of the top crosses did not yield more than the parental mean.

TABLE 17.—NUMBER OF TOP CROSSES YIELDING SIGNIFICANTLY HIGHER THAN THE MEAN OF THE PARENTAL VARIETIES

Inbreds from	*Testers*								
	Lagos White			*Eafro 231*			1 *Sicaragua*		
	A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
Mexico 5	34	9	29.4	—	—	—	—	—	—
Diacol-V.153	61	61	100	—	—	—	—	—	—
Akwete White	—	—	—	21	5	23.8	—	—	—
Ikom White	—	—	—	46	12	26.1	—	—	—
Bende White	11	10	99.9	35	8	22.9	21	1	4.8
Bende Local	22	19	86.8	25	0	0	21	5	23.8
Ugep White	57	27	48.4	40	8	20.0	58	9	15.0
TOTAL	185	126	68.1	167	33	19.1	100	15	15.0

N.B. *A* = Total number of top crosses;
B = Number of top crosses superior to mean of parents;
C = Percentage of superior top cross.

Some of the inbred lines of Ugep White which showed fair general combining ability with the three testers were selected for inclusion in mass selection programme in which inbred lines of Lagos White and Ugep White will form the original composite.

COWPEA BREEDING

Classification of cowpea

Preliminary work on the classification of cowpea was described in the 1965/66 Annual Report. Further work has shown that there were duplications of some varieties in our type collections and that many of them were mixtures of two or more varieties. After the duplications had been removed and the mixtures sorted out, 297 varieties were planted in the third week of June 1966 at Ibadan. Observations were recorded on 5 to 10 plants per variety. Among the 25 characters observed were growth habit, number of days from sowing to the beginning of flower opening, number of seeds per pod, seed size, and texture of seed coat.

Three growth habits were distinguished, namely, erect, semi-erect and prostrate. Only 4.4 per cent of all the varieties were erect; 51.5 per cent were semi-prostrate and 44.1 per cent were prostrate. The relationship between growth habits and the other four characters mentioned above were studied as frequency distributions and the results for three of them are summarised in Tables 18, 19 and 20.

All the erect varieties, 87 per cent of the semi-erects and 35 per cent of the prostrates were early flowering. Most of the erect (61.5 per cent) and semi-erect varieties (80.4) had small seeds; 63.4 per cent of the prostrate varieties had large seeds. Thus, only 38 per cent of all the varieties had large seeds and about half of these had extra-large seeds (over 20.6 gm per 100 seeds).

TABLE 18.—THE DISTRIBUTION OF SEED SIZES AMONG THE THREE CLASSES OF PLANT HABIT

Growth habit	*Seed sizes*			*Total*
	Small (under 10.5 gms)	*Medium (10.6-15.5 gms)*	*Large (over 15.6 gms)*	
Erect	8	4	1	13
Semi-erect	34	89	30	153
Prostrate	13	35	83	131
TOTAL	55	128	114	297

TABLE 19.—THE DISTRIBUTION OF NUMBER OF SEEDS PER POD INTO THE THREE CLASSES OF PLANT HABIT

Growth habit	*Number of seeds per pod*				*Total*
	Low under 10	*Medium 11–15*	*High over 16*	*Not recorded*	
Erect	1	11	1	0	13
Semi-erect	3	86	60	4	153
Prostrate	3	101	21	6	131
TOTAL	7	198	82	10	297

Most varieties had 11 to 15 seeds per pod, although few had below 10 or above 16. Generally, there was great variability in the number of seeds per pod and in seed size, which means that varieties may be effectively selected for high number of seeds per pod and for large seeds. Most varieties also had smooth seed coats, although 56.5 per cent of the prostrates had rough coats.

TABLE 20.—THE DISTRIBUTION OF THE FOUR CLASSES OF SEED COAT TEXTURES INTO THE THREE CLASSES OF PLANT HABIT OF GROWTH

Growth habit	*Seed coat textures*			*Total*
	Smooth	*Rough*	*Cracked*	
Erect	13	0	0	13
Semi-erect	138	12	3	153
Prostrate	56	74	1	131

Cowpea varietal trials

There is a dearth of information about seed yield and its components in the cowpea. In 1965, replicated yield trials were carried out at Samaru and Ibadan and the results described in the 1965/66 Annual Report. In 1966, 25 varieties of day-neutral and short-day types were separately planted. The day-neutral types were planted at Ibadan, Umudike and Samaru on three separate dates, namely, the third week of April, first week of May and the last week of June. The short-day types were planted at Samaru in the third week of July.

The yield of dry beans was of the order of 300 to 1300 lbs. per acre among day-neutral varieties and 80 to 600 lbs. among the short-day varieties.

TABLE 21.—THE VARIATION IN YIELDS AND IN THREE PLANT CHARACTERS ASSOCIATED WITH YIELDS OF COWPEAS AT SAMARU

Plant character	*Varietal range*	*Mean*	*Stand deviation*
Number of pods per plant (X)	14.0-38.6	23.4	±6.6
Number of seeds per pod (Y)	12.2-16.5	14.4	±1.4
Weight of 100 seeds (Z) gms.	7.0-15.0	12.0	±2.0
Yield in lbs. per acre (W)	312.-1304	863.0	±280.8

TABLE 22.—THE VARIATION IN YIELD AND IN THREE PLANT CHARACTERS ASSOCIATED WITH YIELDS OF COWPEA AT SAMARU

Plant character	*Varietal range*	*Mean*	*Stand deviation*
Number of pods per plant (X)	8.2-29.1	27.6	±4.1
Number of seeds per pod (Y)	7.6-15.5	12.4	±1.7
Weight of 100 seeds (Z) gms.	9.7-19.4	13.9	±2.7
Yield in lbs. per acre (W)	82.0-621.0	328.0	±112.5

There was much variation between varieties in the number of pods per plant (X) beans per pod (Y) mean weight per bean (Z) as shown in Tables 21 and 22. And there were significant correlations between these components and final bean yield, W, Table 23.

TABLE 23.—CORRELATION COEFFICIENTS BETWEEN YIELD COMPONENTS AND FINAL BEAN YIELD

Yield components	*Correlation Coefficient*	
	Dayneutral	*Shortday*
XY	0.553**	0.627**
XW	0.894***	0.763**
YW	0.844***	0.691*
ZW	—	0.499*

* P = 0.05
** P = 0.01
*** P = 0.001

COWPEA PHYSIOLOGY

Growth analysis

Before now very little physiological work has been done to determine the physiological basis of bean yield and yield differences between varieties of cowpea. The breeders showed that there is wide variation in varietal bean yield (e.g. Tables 21 and 22). A preliminary greenhouse experiment was done to study growth, development and bean yield of two varieties, New Era and Adzuki, with contrasting yields.

The variety, New Era, was a bigger plant than Adzuki. It produced five times more dry matter and leaf area than Adzuki. But it produced only 1.6 times more dry beans than Adzuki. This showed that New Era was less efficient than Adzuki in converting its dry matter to bean production. Detailed study of dry matter production and distribution showed the following.

During any interval the variety New Era produced more dry matter than Adzuki. From the beginning of fruit development to fruit maturity increasing fraction of the currently synthesised assimilate was imported into the fruit. Larger fractions were imported to the Adzuki fruit than into the fruit of New Era. Shortly before full maturity, all the current assimilate was imported into the fruit of Adzuki, whereas only about 48 per cent went into the fruit of New Era, the remainder being in the leaves and stem.

New Era also produced more flower buds than Adzuki. Most of these dropped prematurely from both varieties, but Adzuki produced more fruits than New Era. Thus, Adzuki was more efficient in fruit production.

The growth parameters of relative growth rate, net assimilation rate and leaf area ratio were not sufficiently different to account for varietal differences in bean yield. It was recommended that germplasm for the high efficiency of dry matter distribution of Adzuki be bred into varieties like New Era.

REPORT ON THE RICE RESEARCH UNIT

It has been shown previously (Federal Department of Agricultural Research Report for 1964/65 p. 40) that it is not possible to obtain one rice variety with a sufficiently wide range of adaptation to cover all the major ecological zones in Nigeria. Hence, rice breeding and agronomy research are done on several sites to meet various problems. Throughout 1966 much work has been done mainly on testing introduced rice varieties at many sites, on breeding for blast resistance, short duration of life-cycle and resistance to lodging. These experiments were done on the three types of rice—upland, swamp, and floating—grown respectively in rainfed uplands, non-inundated irrigable lowlands and naturally inundated lowlands.

UPLAND RICE

Regional variety trials

Five varieties, OS6, OS4, R66, E425 and Bikom were selected from the vairetal collections of 1963 and 1964 and compared at 11 centres with the standard variety Agbede 16/56. As in previous years, the variety OS6 produced outstanding grain yields in these trials. It produced significantly greater yield than Agbede 16/56 at Ado-Ekiti ($P=0.001$), Wasimi, Irruwa, Obior, Jema'a ($P=0.01$), Gogon Gari and Oturkpo ($P=0.05$). Although a joint analysis of all the centres could not be done because the variances were not homogenous, the average grain yield per acre of OS6 (2976 lbs.) was higher than that of Agbede 16/56 (2216 lbs.) by 34.3 per cent.

The variety OS6 has not been recommended to the Ministries of Agriculture of Western, Midwestern and Eastern Nigeria to replace Agbede 16/56, and to the Ministry of Agriculture of Northern Nigeria for cultivation in southern Zaria.

Breeding for resistance to blast, caused by Pyricularia oryzae

The breeding programme to produce blast resistant upland rice varieties continued at Moor Plantation in 1966. The swamp variety, Tjina, which is very resistant to blast, was crossed with three high yielding but blast-susceptible upland varieties Agbede 16/56, V1.28061 and Jete. The F_3 generation of 1148 plant progenies selected from these crosses was grown in concrete tanks under upland conditions and observed for segregation of blast resistance, grain type and life-cycle duration. Only 97 blast resistant, long-grain, short duration individuals were selected from them for further study in the F_4 generation. When these were grown plants were selected which combined the following characteristics—early maturity, long grain, short straw and erect habit—and retained for further study in the F_5 generation during 1967.

IRRIGATION OF SWAMP RICE

The objectives of shallow swamp rice breeding programme are to produce high yielding, blast resistant varieties with the same or shorter life duration than Mas 2401.

Trials of introduced varieties

Different batches of introduced varieties were compared with standard varieties Mas 2401 and BG.79 at several places, using Badeggi as a central testing site for each batch of varieties.

Sixteen high yielding varieties selected from the 1962-64 collection were compared with Mas 2401 and BG.79 at Badeggi. The variety Biribra E.37 produced the highest grain yield of 5092 lbs. per acre. Its yield and that of the variety SR-26B were significantly higher than that of BG.79, but were not significantly different from that of Mas 2401.

Another batch was compared with Mas 2401 at Badeggi, Bende and Warri. 17 varieties of medium duration produced significantly greater grain yield than Mas 2401 at Badeggi, 24 at Bende, and only one—SML 140/10—at Warri. Three of these varieties, Kaliloe-50, BP1-76 and SML 140/10 were highly resistant to blast at Badeggi and Bende.

Twenty-five varieties selected from the 1963–65 collection were compared with BG.79 and Mas 2401 at Badeggi, Bende and Abakaliki. In a joint analysis of the data the error variances from the three places were homogenous, and there was a significant variety × place interactions. The yields of the four SML lines imported from Surinam were outstanding in these trials. The average yield per acre of SML 140/5 and SML 140/10 were 4402 and 3679 lbs. and those of BG. 79 and Mas 2401 were 2517 and 2470 lbs. respectively. The average yields at Bende and Abakaliki were significantly greater than those at Badeggi.

Variety trials for yield

Trials on rainfed swamps — Previous trials in the area around Ago-Amodu were described in the report for 1964/65 and 1965/66. In 1964, the variety D 114 produced the highest yield.

This year, seven varieties were compared here to select the best for cultivation in the shallow flooding clay basins of Shaki area. Mas 2401 yielded more than BG.79 although there was no significant difference between their yields nor between those of Makalioka-823, D 114 and D 99.

Trials on saline-alkaline soils—Previous trials on the saline-alkaline soils of the Yau and Yobe irrigation scheme at Lake Chad have been described in the report for 1964/65 and 1965/66. This year six medium varieties were compared for yield at Yau. As in last year, the variety De-Gaulle produced the highest grain yield (5903 lbs. per acre) although this was not significantly different from the yields of BG.79, Mas 2401 and HMA-9.

Breeding for lodging resistance

The breeding programme to produce the lodging resistant varieties was continued. Pedigree line selections derived from the three crosses were carried out in replicated trials at Badeggi, Bende and Warri. At Badeggi 35 pedigree lines were compared in two trials with Mas 2401, BG.79 and Tjina as standard varieties. There were significant differences between the progeny yields but none of them were significant. However, on the basis of high lodging resistances and higher yield 12 promising progenies have been retained and will be tested in 1967.

Breeding short duration varieties

Short duration—The breeding programme to produce short duration varieties was continued at Badeggi and Bende. Fifty-seven progenies were compared with BG.79 and Mas 2401 in yield trials at both centres. Twenty-seven progenies gave higher yields than BG.79 but the differences were not significant at Badeggi. Twenty-one progenies gave higher yield than BG.79 but the differences were not significant. None gave higher yield than Mas 2401 at either centre. On the basis of higher yield and shorter duration than BG.79, ten progenies have been retained for further trial in 1967. Progenies from the crosses BG.79 × Taichu-65 and Taichu-65 × BG.79 appear to be more promising, whereas the progenies from the crosses BG.79 × MUT-9, BG.79 × Precose and GEB24/37 × Precose are of low yield potential and are highly susceptible to rice blast, both in the nursery stage and at flowering.

Breeding for resistance to *Pyricularia oryzae*

Screening of introduced varieties—The uniform blast nursery technique has been developed to test varieties for resistance to blast disease caused by **Pyricularia oryzae.** Seedlings of varieties under test are grown in upland nurseries between rows of susceptible seedlings which are heavily infected with the disease. Under these epiphytotic conditions very precise selection for resistance is carried out. A total of 240 introduced varieties were screened for resistance. Six varieties were classified as highly resistant and 25 as resistant. About 425 hybrid progenies from the crosses in the trials were also screened. All susceptible seedlings were discarded.

Screening of the varieties for the resistance to rice blast at the substations was also carried out. Considerable differences in levels of resistance were noted between Badeggi, Bende and Warri. For example, the variety HMA-9, which appears highly resistant (Class 1) at Badeggi was scored as resistant, (Class 2) at Warri and susceptible (Class 5) at Bende. These differences in disease reaction between stations indicate the existence of more than one race of pathogen **(Pyricularia oryzae)** in Nigeria. The recently introduced blast resistant varieties Raminad, H5, Tadukan, and Peta, which are used as parents in the breeding programme to produce blast resistant hybrids, were classified as highly resistant at Badeggi and Bende centres. The F_3 and F_4 hybrids derived from the diallele crosses between these blast resistant varieties and Tjina were also found to be either resistant or highly resistant at both the centres.

Nine varieties were tested for resistance to rice blast at Barkin Ladi. They were compared with the standard recommended variety D99 in this area. Four varieties, Tjina,

XA-79, HMA-9 and Dissi-Hi proved resistant to blast and appear to be suitable for cultivation in this area. Of these varieties only XA-79 gave significantly greater yield than D99.

Yield trials of selected Blast-resistant varieties—Badeggi

Fourteen varieties were selected for high blast resistance in screening tests on uniform blast nurseries in 1964. They were compared with Mas 2401 and BG.79 in a trial at Badeggi. The blast resistant variety SC.308/51 gave highly significantly greater yield than Mas 2401 but was not significantly different from that of BG.79. Other resistant varieties, HMA-9, Gambiaka Sebela, Padi Sawa III, Radin Siak-34, and Fossa produced significantly greater yields than Tjina.

Seven blast resistant varieties imported from the International Rice Research Institute, Philippines in 1964 were selected as highly resistant to blast in Nigeria from the uniform blast nursery tests. They were compared with Mas 2401, and Tjina in a trial at Badeggi. BP1-76 was the highest yielding variety with erect growth and high resistance to blast in the field. There were no significant differences between the yields of BP1-76, Mas 2401, H4, Peta Tjina and H5, and all the six varieties produced significantly greater yields than Acheh, Tadukan and Raminad.

Five progenies from the cross combinations between (*a*) HP1-76 × Peta, (*b*) Tadukan × H5, (*c*) Tadukan × H4, (*d*) Peta × Tjina, and (*e*) H4 × H5, gave high yields ranging from 3110 lbs. to 3776 lbs. per acre. Another set of a series of crosses, to produce short duration, blast resistant lines, was commenced in 1965. Twenty-three F_2 populations of the different cross combinations were planted in the late season. Segregation was observed for the time of flowering, blast resistance and grain type characters. Plants which were susceptible to neck-rot and those with long life-cycle were discarded from each hybrid population. The remaining plants from each cross were harvested to form F_3 seeds which will be tested in 1967.

FLOATING RICE

Floating rice is grown in areas which are subject to seasonal deep flooding. In Northern Nigeria the traditional rice species grown in these inundated plains of river valleys is *Oryza glaberrima*, which has red grains. The objective of the breeding programme for this area is to replace this type of rice with *Oryza sativa* so as to produce varieties with long, white grains. Consequently, the variety Mali Ong was recommended for cultivation in the Birnin Kebbi area of the Sokoto valley (F.D.A.R. Annual Report 1964/65 p. 64). The life cycle of this variety is long, and it may not be appropriate for cultivation in areas where the floods persist for shorter periods than at Birnin Kebbi. The improvement programme is now aimed at the production of varieties with shorter duration and higher yields than Mali Ong.

Variety trials—Badeggi

Varietal trials to compare the yields and duration of varieties of *O. sativa* and *O. glaberrima* were continued at Badeggi. This year Mali Ong was compared with 11 varieties of *O. sativa* and two of *O. glaberrima*. The variety Dan Boto (*O. glaberrima*) produced significantly more grain than Mali Ong. Two varieties of *O. sativa*, Indo China Blanc and Nang Rei, produced more grain than Mali Ong, although the differences between their yields were not statistically significant. However, these two latter varieties had a shorter life-cycle than Mali Ong.

Breeding for short duration varieties

Work has continued in the programme to obtain high yielding, short duration varieties through intraspecific hybridization. Thirty-four progenies from three crosses between the high yielding varieties Mali Ong, Champa, and Indo Chine-53 and the short duration Indo Chine Blanc were compared with Mali Ong and Indo Chine Blanc at Badeggi. Fifteen progenies gave a significantly greater yield than Mali Ong and all of them matured earlier

than Mali Ong. Seven progenies still shared segregation for grains of B and C types. Selection within these progenies for B type grained individuals will be carried out in 1967. Segregation for the floating and non-floating habits was observed.

Progenies from 39 individual plant selections made in 1964 also were compared with Mali Ong in their F_6 generation. Six progenies from them produced significantly greater yield than Mali Ong and were of shorter duration too. However, segregation for blast resistance in the nursery and for floating habit in the field was observed in these progeny populations.

A trial of 12 progenies selected from the group of the individual plant selections at Badeggi was planted in non-replicated plots at Birnin Kebbi and compared with Mali Ong and Indo Chine Blanc. Nine progenies gave higher yields than Mali Ong and all were of shorter duration than Mali Ong. Only two progenies gave higher yield than Indo Chine Blanc which was a higher yielding and shorter duration variety than Mali Ong at Birnin Kebbi.

Thirteen selected progenies were put through an additional generation in the dry season of 1965, using a dark chamber to shorten their life periods. They were compared in F_7 generation with replicated control plots of Mali Ong and I.C.B. Seven progenies gave significantly greater yields than Mali Ong. All progenies were earlier than Mali Ong and were more uniform in their flowering and grain type. Eight progenies from another series of crosses, in which swamp varieties BG.79 and Bhendot T.100 were crossed with floating varieties Mali Ong and Tisei to combine the vigour and floating habit with earliness of maturity, were compared with Mali Ong and I.C.B. at Badeggi. Only progeny 44/1 appeared to be a good floating type, but with less grain yield than Mali Ong and I.C.B.

Interspecies hybridization

In a breeding programme to combine the vigour and flood resistance of *Oryza glaberrima* with white grain and non-shattering habit of *Oryza sativa*, 15 interspecies hybrid progenies were compared with Mali Ong, I.C.B., and Dan Boto, at Badeggi. These progenies were in F_8 generation and still showed a high degree of segregation for characters like height, floating habit, stem colour, awns, flowering time and self sterility. Individual plant selections of a combination of floating habit, early flowering, high yield and white grained plants were made in this season. Twenty-six plants are selected and retained for further trial in 1967.

REPORT ON THE PLANT PATHOLOGY DIVISION

RICE DISEASE

Seed health testing

Helminthosporium oryzae and *Pyricularia oryzae* were found to be the two most important pathogens in the 1965 seeds tested in 1966. This observation is summarized in Table 24.

TABLE 24.—INCIDENCE OF HELMINTHOSPORIUM ORYZAE AND PYRICULARIA ORYZAE IN SEED SAMPLES FROM THE 1965 RICE CROP

Group of provinces	*No. of samples*	*Helminthosporium oryzae (Brown spor)*		*Pyricularia oryzae (Blast)*	
		No. of samples infected	*Average % infection of infected samples*	*No. of samples infected*	*Average % infection of infected samples*
Western	81	65	21.0	25	1.3
Midwestern	25	19	10.2	3	1.7
Eastern	23	9	1.4	10	1.0
Northern	126	92	3.2	7	0.8
TOTAL	255	185	35.8	45	4.8

MAIZE DISEASES

Rust

A collection of 17 isolates of *Puccinia polysora* from Moor Plantation was tested against six maize differentials to determine the number of races of *P. polysora* present. Reactions of the maize differentials indicated this collection contained four races of *P. polysora*.

An experiment to determine the reduction in yield caused by maize rust showed that the yield of Lagos white was reduced by 44 per cent, and that of NS.1 by 29 per cent. The former is therefore a more susceptible variety than the latter.

COWPEA DISEASES

Cowpea virus disease resistance tests

Screening tests for resistance to cowpea yellow mosaic virus (CYMV) and cowpea mottle virus (CMeV) were made separately on nearly 300 varieties of the type collection.

Table 25 gives the varieties that were resistant to CYMV and CMeV. Twenty varieties had combined resistance to both the viruses, 33 to CYMV, and 16 to CMeV. Twenty-three of the 33 varieties resistant to CYMV had more than 50 per cent of their plants resistant to CMeV, and three of the 16 varieties resistant to CMeV contained plant resistant to CYMV.

TABLE 25—COWPEA VARIETIES RESISTANT TO COWPEA YELLOW MOSAIC AND COWPEA MOTTLE VIRUSES

Varieties resistant to					
CYMV and CMeV		*CYMV*		*CMeV*	
Acq. No.		Acq. No.		Acq. No.	
6441M2	Arlington–A	6412 a	2510421–Alabama	6443	Davislea Alabama
6463	Icormaxi–A	6430	Extra Early–A	6475	New Era IDS
6478	C5715–2	6434	Iron A–1	6482	C5715–4
64104	Havana–A	6435 a	Early Red	6492	Kwarakwoi
64110	Chinese Red	6438M	Extra Early–C	64106 b	C5715–4
64126	Victor K7986	6441	Arlington–A	64122M1	Brabham 892–B
64138	Taylor	6442	Mississippi S1–A	64154M1	56–16
64156	C5773–24	6455	Jackson Purple Hull–A	64154M2	56–17
64171	Instant 105	6457	Paraguay 5	64269 b	C5714–1–4
64184	Taylor Blue Goose	6486 a	Gashar Chinto	64287	C5723–1
64186	Dan Konta-gora	6488	Virginia Pea	64305	V–172–2
64188	Bechuana	64105	C5810–4	64340 b	C5810–1
64204	C5711–3	64105M2	C5810–6	64344	Brown Eye Purple Hull
64208	Alabunch	64116 a	56–11	64368	Obuasi–A1
64214M1	Nine Check-9	64119 a	Reeves–A	64398	Nigeria–A37
64220M1	Kuru Pea	64132 a	Hachivacha–A		
64294	Texas Purple	64168M1a	Brown Mauritiue		
64338	Alabama Crowder	64175 a	Calhoun Crowder		
		64176 a	II–V–5–6		
64349	C5711–1	64180M3 a	Brown Crowder-G		
64468	Matawase–A	64195 a	C5714–17		
		64217 a	Machakos–B		
		64221 a	C5715–8		
		64229 a	Paraguay 6		
		64234M1a	Pinko		
		64235 a	Poona–A		
		64243 a	Variegated–A		
		64247 a	Victor–A		
		64282 a	Barakin–A		
		64342M1 a	C574–2		
		64452 a	India C521		
		64461	Tanong–10		

a—50 per cent plants in these varieties were resistant to CMeV.

b—50 per cent plants in these varieties were resistant to CYMV.

REPORT ON THE PLANT INTRODUCTION AND PLANT QUARANTINE SERVICES

LAGOS—The Administrative Headquarters of the Plant Quarantine Service remained at Lagos. The Plant Importation Control work was continued. Imported Plant materials were examined at the following places in Lagos—

(*a*)	*Lagos Airport, Ikeja:*	Airport Baggage Hall and Airport Freight Shed.
(*b*)	*Lagos Custom Quays, Marina:*	Thirteen Cargo sheds.
(*c*)	*Apapa Wharf*	General Post Office, Marina.
(*d*)	*Idiroko (Nigeria/Dahomey Border):*	Baggage and Vehicle Inspection.

Inspection work at Lagos continued to be hampered by lack of adequately trained Plant Quarantine Inspectors and lack of Departmental Quarters for the staff. The Horse-fall Incinerator which was installed at the Lagos Airport, Ikeja continues to function very well.

IBADAN—Post-entry quarantine and Plant Introduction remained at Ibadan. Import Permits for Plant Materials meant for propagation were issued at Ibadan and inspection of imported plant materials were also done at Ibadan.

KANO—Kano station was temporarily closed down as a result of the national crisis and was re-opened in March 1967. The station is at present manned by two personnel of Northern origin. The office remained at the International Airport, Kano.

PORT HARCOURT—With the transfer of a Technical Officer and an Agricultural Assistant to Port Harcourt, efficiency in the inspection of plant materials entering through Port Harcourt Quays has been greatly improved. Meanwhile, inspections were carried out at the General Post Office, Sea Passenger Baggage Hall and the four Cargo Sheds in the Wharf.

CALABAR—One of the oldest Plant Quarantine stations in the country was manned by an Agricultural Assistant. Examinations of imported plant materials were carried out at the Ivy Wharf, the Airport, and the General Post Office.

SAPELE—This Midwest station, serving the ports of Koko, Sapele and Warri, was temporarily closed down in January 1966 and re-opened in October 1966. One Field Overseer Grade II was in-charge of this station. Since the re-opening of the station, only one consignment of imported plant materials has ever been recorded and this interception was made by the Higher Technical Officer when he was on tour to the stations.

IDIROKO—This station was opened early in 1966 and caters for Border inspection. An Agricultural Assistant was in-charge of the station throughout the period. Pop-corn was intercepted from the United States of America.

KADUNA—This station has been temporarily closed because of the national crisis and should re-open as soon as the situation returns to normal.

As soon as staffing position improves, more stations shall be opened between Nigeria and Cameroon, Chad and Niger.

PERMITS—One thousand, three-hundred and thirty-six (1336) import permits were issued during the period at Ibadan and Lagos. The table below shows the permits issued in the last four years.

TABLE 26.—PERMITS ISSUED FROM 1963-67

Year	1963-64	1964-65	1965-66	1966-67
Permits issued	495	835	914	1,336

The plant materials for which permits were issued included restricted vegetable seeds, flower seeds, vegetative materials of ornamentals like carnations, bulbs and tubers; economic plants like *Hibiscus* spp. (Kenaf); *Gossypium* spp. (cotton); *Theopbroma Cacao* (cocoa) ; *Mangifera indica* (mangoes); *Pyrus malus* (apples); *Vitis vinifera* (grapes), *etc.*

INSPECTION—The total number of consignment of plant materials examined on importation at all the Plant Quarantine inspection ports was five thousand, one hundred and twenty-two (5,122).

Among intercepted items are—Sunflower, Tobacco, Paddy Rice, Oil Palm, Capscum, Black Pepper, Kenaf and Cocoa Seeds; Sugar Cane Cuttings, Budwoods of Cocoa, Rubber, Citrus and Mango trees; Ginger (Rhizome), Tigernuts, Grass Stolons; Potato and Yam tubers, Onion and Flower bulbs; Seedlings of Fruit and Ornamental plants and also Grape Vine plants. Assorted fruits, such as Apples, Peas, Apricots, Arkidinia, Citrus, Mangoes, Almonds, Pomengranate, Tomato, greengages, Nectarines, Peaches, and Plums.

PLANT EXPORTATION—Inspection of Plant materials for export continued throughout the period and a total of 134 Phytosanitary Certificates were issued at Ibadan, Lagos and also by the Authorised Agencies at NIFOR, Benin; Institute of Agricultural Research, Zaria; and Director of Forest Research, Ibadan.

APPENDIX I.

ANNUAL REPORT ON METEOROLOGICAL DATA 1966

METEOROLOGICAL STATION—MOOR PLANTATION, IBADAN.

(Latitude 7°23' N.; Longitude 3°51' E.; Altitude 574 feet)

Month	*Rainfall in Inches*	*Ten Years Average in inches*	*No. of Wet Days*	*Cumulative Total in inches*	*Mean Relative humidity %10.00 a.m.*	*Maximum Temperature 10.00 a.m. (°F)*	*Minimum Temperature 10.00 a.m. (°F)*	*Mean Temperature 10.00 a.m.*	*Mean Daily Duration of Sunshine*
January	1.43	0.08	2	1.43	77.8	92.5	69.4	81.0	6.1
February	NIL	0.32	NIL	1.43	75.0	96.5	71.1	83.8	7.3
March	3.82	3.70	10	5.25	79.4	95.6	73.2	84.4	6.6
April	5.58	4.54	12	10.83	82.4	91.6	72.8	82.2	5.8
May	6.52	6.44	12	17.35	81.6	89.0	71.7	80.4	5.8
June	10.47	9.19	19	27.82	84.3	88.1	70.3	79.2	6.0
July	5.17	7.39	16	32.99	86.1	85.9	71.5	78.7	3.9
August	4.67	5.27	17	37.66	88.6	83.8	71.4	77.6	2.4
September	9.42	5.27	16	47.08	87.0	85.5	71.2	78.3	3.3
October	6.34	6.79	16	53.42	84.3	88.0	70.5	79.3	5.9
November	1.64	2.05	4	55.06	83.4	91.2	71.2	81.2	7.0
December	0.61	0.37	1	55.67	82.1	91.8	68.6	80.2	6.9
TOTAL	55.7	134.8	125	346.0	992.0	1079.5	852.9	966.3	67.0
MEAN	4.6	11.2	10.4	28.8	82.7	89.9	71.1	80.5	5.5

APPENDIX II

ANNUAL REPORT ON METEOROLOGICAL DATA 1966

METEOROLOGICAL STATION—BADEGGI

(Latitude 9°07' N.; Longitude 6°08' E.; Altitude 225 feet)

Month	*Rainfall in inches*	*Ten Years Average in inches*	*No. of Wet Days*	*Cumulative Total in inches*	*Mean Relative humidity %10.00 a.m.*	*Maximum Temperature 10.00 a.m. (°F)*	*Minimum Temperature 10.00 a.m. (°F)*	*Mean Temperature 10.00 a.m.*	*Mean Daily Duration of Sunshine*
January	NIL	0.49	NIL	NIL	57.0	93.7	62.9	78.3	8.40
February	NIL	0.27	NIL	NIL	32.0	97.8	62.9	80.4	8.80
March	0.07	1.00	1	0.07	51.0	100.5	73.1	86.8	8.00
April	1.74	2.29	6	1.81	64.0	97.1	76.7	86.9	7.50
May	6.45	5.51	11	8.26	74.0	93.3	74.9	84.1	7.02
June	8.93	7.59	15	17.19	82.0	89.2	73.0	81.1	7.56
July	8.30	8.28	14	25.49	84.0	88.0	73.0	81.0	6.70
August	10.88	7.90	17	36.37	88.0	87.0	73.0	78.0	4.10
September	13.02	9.84	21	49.39	83.9	86.0	73.0	79.5	5.60
October	3.32	3.96	8	52.71	76.6	91.7	74.1	80.9	7.80
November	NIL	0.40	NIL	NIL	70.8	93.0	71.0	81.9	10.00
December	NIL	0.07	NIL	NIL	61.2	92.5	62.7	77.4	8.3
TOTAL	52.71	55.11	93	191.29	824.5	1109.8	850.3	976.3	89.78
AVERAGE	4.39	4.59	7.75	15.94	68.71	92.48	70.86	81.36	7.48

APPENDIX III

AN ANALYSIS OF THE ESTABLISHMENT 1966-1967

The authorised establishment of Senior Staff at the beginning of the year, and the actual strength as at 31st March, 1967, are given below

Ranks	*Establish-ment*	*Posts Filled*	*Vacancies*
I. Administrative and Professional			
Director	1	1	—
Deputy Director	1	1	—
Principal Research Officers	5	5	—
Senior Research Officers and Research Officers	48	29	19
Librarian	1	—	1
TOTAL	46	36	20
II. Executive Technical Staff			
Technical Officers	16	17	—
Assistant Technical Officers	19	15	4
Senior Laboratory Technologist	1	—	1
Higher Laboratory Technologist	3	1	2
Laboratory Technologists	6	3	3
Asst. Laboratory Technologists	11	3	8
Senior Technical Officer	1	—	1
Higher Technical Officers	3	3	—
Mechanical Demonstrator	2	1	1
TOTAL	62	43	20
III. Executive (Administrative)			
Principal Accountant	1	1	—
Higher Executive Officer	1	—	1
Executive Officer (General)	1	1	—
Executive Officer (Accounts)	1	1	—
Asst. Executive Officer (General)	2	1	1
Asst. Executive Officer (Accounts)	4	2	2
Library Officer	1	1	—
Personal Secretary	1	1	—
TOTAL	12	8	4
Grand Total, Senior Staff	130	87	44

The authorised establishment of junior staff at the beginning of the year, and the actual strength at 31st March, 1967, are given below

Ranks	*Establish-ment*	*Posts filled*	*Vacancies*
IV. Clerical			
Chief Clerk	1	1	—
Asst. Chief Clerks	2	1	1
First-Class Clerks	11	10	1
Second-Class and Third-Class clerks	29	19	10
Library Clerks	2	1	1
Stenographers, Grades I & II	2	1	1
Storekeeper Grade I	1	1	—
Storekeeper Grades II & III	7	3	4
TOTAL	55	37	18
V. Technical			
Senior Agric. Asst. Grade I	1	1	—
Senior Agric. Asst. Grade II	4	5	—
First Class Agric. Lab. Technician	2	—	2
Agric. Assistant Grade I	18	13	5
Agric. Assistant Grades II & III	85	64	21
Second & Third Class Agric. Lab. Tech.	21	16	5
Senior Photographic Asst. Grade I	1	1	—
Draugthsman Grade II	1	1	—
TOTAL	133	100	33
VI. Minor Technical & Sub-Clerical			
Senior Field Overseers	8	5	3
Field Overseers, Grades I & II	68	61	7
Artisans	36	30	6
Senior Driver/Mechanic	1	1	—
Driver/Mechanics	12	11	1
Clerical Assistants	14	10	4
Typists	18	18	—
Meteorological Recorder	1	1	—
Senior Lab. Attendant	1	1	—
Laboratory Attendants	13	11	2
Store Assistants	4	5	—
Telephone Attendants	3	2	1
Store Attendants	2	2	—
Duplicating/Gestelith Operator	1	1	—
Head Messenger	1	1	—
Messengers	18	18	—
Total Minor Techn. & Sub-clerical	202	178	24
Grand Total Junior Staff	390	315	66

VII. Progress of Nigerianisation as at 31st March, 1967

Type of Post	*Nigerian*	*Expatriate*		*Vacant*	*Total*
		(*P*)	(*C*)		
Administrative and Professional	28	4	4	20	56
Executive (Technical)	42	—	1	20	63
Technical	100	—	—	33	133
Minor Technical	123	—	—	20	143
Executive (Clerical)	8	—	—	4	12
Clerical	37	—	—	18	55
Sub-clerical	55	—	—	4	59
TOTAL	393	4	5	119	521

(*P*) = Pension; (*C*) = Contract Terms.

VIII. The number of Nigerians known to be undertaking higher training to qualify themselves for posts in the Department were as follows:

	B.Sc.	*M.Sc.*	*Ph.D.*	*Total*
Agriculture	1	—	—	1
Botany	1	—	—	1
Chemistry	—	—	—	—
Mathematics	1	—	—	1
Zoology	—	—	—	—
Plant Pathology	—	2	—	2
Microbiology	—	—	—	—
Agronomy	2	—	—	2
Physiology	—	—	1	1
TOTAL	5	2	1	8

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